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Case Report

Bilateral Iliac Endobypass Solution in Iliac Artery Rupture during TEVAR Procedure: A Case Report and Review of the Literature

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Iliac artery rupture is a demanding complication that can occur during endovascular procedures, particularly when large-caliber introducers are required. We present the first case in the literature on the endobypass technique, a quick and effective reconstruction method for the iliofemoral axis. This clinical case highlights that thoracic endovascular aortic repair procedures require large-caliber introducers into the femoral and iliac arteries to allow passage of the delivery system. These arteries may be diseased, representing a high risk of rupture. In our case, placing a 20 Fr introducer, the iliac artery ruptured bilaterally. Therefore, we performed an endobypass deploying Viabahn stent-grafts into the common iliac artery and manually performed distal anastomosis on the femoral bifurcation.

Key Words: Surgical anastomosis, Endovascular procedures, Iliac artery, Thoracic aorta, Sutures

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INTRODUCTION

Aortic pathologies including aortic arch aneurysm, descending thoracic aortic aneurysm (DTAA), type B aortic dissection, and penetrating aortic ulcers (PAUs) can be managed with endovascular surgery through endoprosthesis implantation. The most common arterial access is the femoral artery, which status is a crucial factor for the success of the procedure. Atherosclerotic stenosis with calcification or extreme tortuosity of the iliofemoral axis can result in rupture, causing a life-threatening complication.

We present the case of a 72-year-old female hospitalized for a pulmonary disease with an incidental finding of aortic dilatation and a large PAU [1,2]. Thoracic endovascular aortic repair (TEVAR) was preferred due to its minimal invasive nature. However, iliac artery passage was challenging in this patient (Fig. 1A). Both iliac arteries showed high grade calcifications, moderate stenoses and tortuosity (Fig. 1B, C).

The need for ethical review and approval was waived for this study by the Institutional Review Board because it was a retrospective study including three or fewer patients. Informed consent was obtained for the publication of this case report.

CASE

A 72-year-old female was admitted to the Emergency Department of San Giovanni Bosco Hospital with the exacerbation of lobar pneumonia and type II respiratory failure. She had a medical history of hypertension, dyslipidemia, chronic obstructive pulmonary disease, and thyroidectomy with consequent hypothyroidism presenting as multinodular goiter and bilateral adrenal hyperplasia. Vascular anamnesis consists of occlusion of the right internal carotid artery. Pulmonary computed tomography (CT) revealed a DTAA and a PAU of 57 mm×40 mm in the posterior aortic wall. The patient was completely asymptomatic of this aortic disease (Fig. 2).

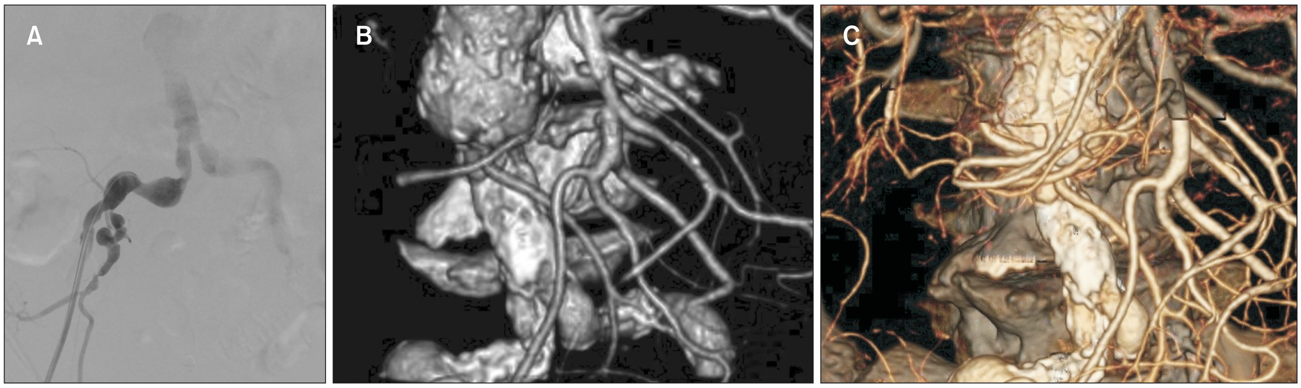

Fig. 1. Iliac arteries angiography at the beginning of the procedure (A) and aorto-iliac 3D computed tomography scans (B, C) showed high-grade calcifications and moderate level of stenosis and tortuosity bilaterally.

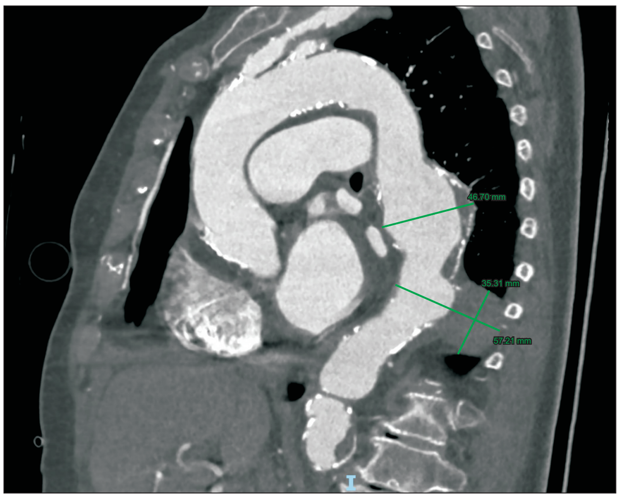

Fig. 2. Thoracic computed tomography scan showed dilated descending aorta (maximum diameter 47 mm with parietal calcifications and thrombotic apposition) and penetrating aortic ulcer (maximum axial diameter 57 mm and cranio-caudal extension 40 mm).

Endovascular repair should be considered for complicated type B PAUs [3,4], which indicates the presence of recurrent pain or PAU that initially measures >20 mm in diameter or >10 mm in depth or progression of the total aortic diameter. Endovascular repair is the preferred first-line treatment [4]. Therefore, she was treated with TEVAR (RelayPro 28-M4-34-200-30S; Terumo Aortic, Inchinnan, UK) with percutaneous 20-Fr femoral access. After bilateral placement of 8-Fr introducers for guide positioning, we pre-dotted the right femoral artery with an 18-Fr introducer (Dryseal; Gore, W. L. Gore & Associates, Flagstaff, AZ, USA) and then changed to a 20-Fr introducer. Due to calcifications of the iliac artery, the right iliac artery ruptured during the placement of the 20-Fr introducer (Fig. 3A). Quickly, we inflated a balloon for hemostasis and placed a stent graft (Viabahn, 7 mm×25 mm) at the iliofemoral artery. However, leakage persisted from the CIA (Fig. 3B); hence, we decided to perform an endobypass technique with a stent-graft 8 mm×25 mm deployed inside the previous stent-graft, using the oversized overlapping at the proximal sealing zone. The distal end of the stent-graft was anastomosed to the CFA in an end-to-side fashion. The suture was performed by crossing the covering expanded polytetrafluoroethylene (ePTFE) canvas, overstepping the most distal nitinol stent. The rupture was safely repaired (Fig. 3C and 4).

To avoid further complications in the upper part of the right CIA, we decided to change the access side of the endoprosthesis delivery system. Therefore, the same procedure was performed on the left side. After placement of the thoracic endoprosthesis for PAU exclusion, angiography showed the same complication on the left side, with evidence of left iliac artery rupture along the 20-Fr introducer (Dryseal). Consequently, we repeated the endobypass technique on the left side with a 7 mm×25 mm stent graft.

DISCUSSION

Endovascular procedures to place aortic endoprostheses require large-caliber iliofemoral access (generally between 18 and 24 Fr). Implatation of endoprostheses are used for the treatment of aortic injury, acute aortic syndrome, aneurysm, or PAUs. PAUs, a subset of aortic diseases, are believed to be closely linked to aortic dissection and intramural hematoma (IMH). They are defined as ulcer-like projections into the medial lining of an artery originating at the site of a soft plaque [3,5]. PAU may result from progressive erosion of atheromatous mural plaques with penetration of the elastic lamina [3].

European Society for Vascular Surgery guidelines recommend that PAUs with a <20 mm diameter or <10 mm depth should be treated medically, followed by serial imaging sur-

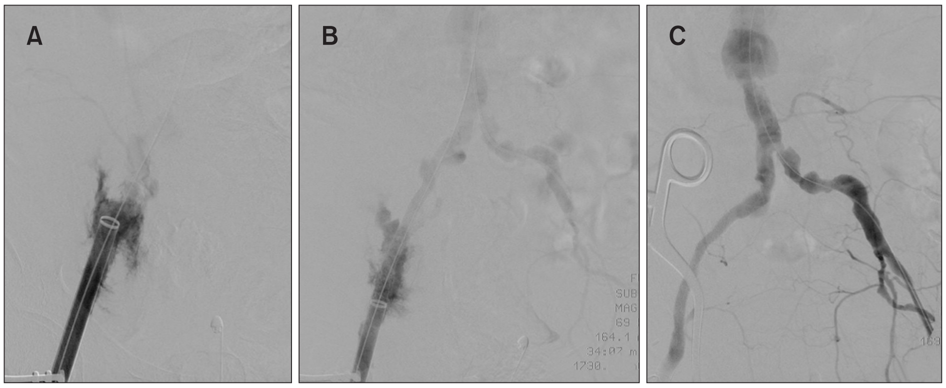

Fig. 3. Angiography of right iliac artery showed the first rupture (A), the rupture permanence after first Viabahn placement in the right common iliac artery (B), and the right iliac-femoral endobypass before thoracic endovascular aortic repair procedure (C).

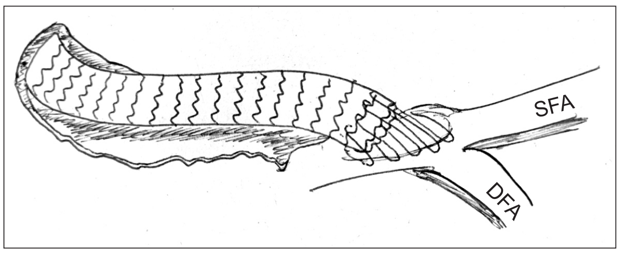

Fig. 4. Endobypass sketch illustrated the anastomosis technique.

veillance [6]. The medical management of PAU is the same as that of type B IMH, which is in line with aortic dissection management [6]. It is based on blood pressure reduction to limit aortic wall stress and reduce the force of the left ventricular ejection. The goal is to reduce the systolic blood pressure between 100 and 120 mmHg and, when attainable, a heart rate below 60 beats/min [7]. The initial medical therapy consisted of β-blockers. In patients who do not respond to β-blockers or who do not tolerate the drugs, calcium channel blockers or renin-angiotensin inhibitors can be used as alternatives. Other alternative therapies include sodium nitroprusside, α1-adrenergic, and nonselective β-blockers [6]. Complicated PAUs have a natural history of pseudoaneurysm formation, dissection, or rupture. Urgent repair is recommended in this setting [3,7].

The incidence of iliac rupture as a complication during endovascular aortic repair (EVAR) and TEVAR procedures described in the literature was 3.9% [8]. Iliac artery injuries are more common in thoracic than in abdominal endograft placement because of the larger percentage of females treated and the larger graft sizes used. Females are at higher risk of rupture (76% vs. 19%; $P<0.001$), and almost all ruptures occur during the use of devices with a ≥20-Fr delivery system [8]. A combination of calcification, tortuosity, and diminished caliber contributes to the risk of iliac rupture, even when the iliac diameter is acceptable. The liberal use of iliac conduits and small-diameter sheaths may be the best preventive strategy [8].

Sutureless anastomotic techniques have been previously described. A similar technique of endobypass was described in an article published in 1996 by Spoelstra et al. [9] for the creation of a femoropopliteal bypass; the distal anastomosis is achieved through the sealing zone between the stent graft and popliteal artery, whereas the proximal anastomosis is obtained by a conventional end-to-end suture with a PTFE suture (Gore). Giudice and Scoccianti [10] also reported the same technique in 2003, with the same purpose of creating a femoropopliteal bypass with an end-to-end suture at the proximal end of the duct. The Viabahn Open Revascularization Technique (VORTEC) was described in 2008 to facilitate supra-aortic and visceral artery revascularization [11]. The target artery was punctured using this technique, and a Viabahn stent graft was introduced through a guidewire using the Seldinger method, with the risk of site complications in the case of heavy arterial wall calcification. In 2011, Bonvini et al. [12] presented the Viabahn Padova Sutureless (ViPS) technique. After standard surgical exposure of the CFA and above-knee popliteal artery, a Viabahn was manually inserted into the popliteal artery under direct vision. The distal anastomosis of the bypass was then obtained by unsheathing the stent graft with a 2.5-cm sealing zone. Conversely, the proximal end of the prosthesis, the ePTFE graft, was tunneled to the groin and sutured to the CFA in a standard end-to-side fashion. The same technique was described by Ferretto et al. [13], consisting of consecutive series of five patients with the peripheral arterial occlusive disease (Rutherford class IV and V) who underwent ViPS procedures for limb revascularization. The ViPS technique differs from the VORTEC technique mainly because it offers a direct view of the inside of the artery after transection, thus minimizing the risk of damaging a calcified or heavily diseased target vessel. Moreover, it allowed the operator to prepare the entire system preoperatively for deployment without additional anastomoses or cumbersome deployment in the operative field [12]. In this

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technique, the introduction of the Viabahn stent graft into the artery was in a "reverse" orientation from its intended commercial use; Piazza et al. [14] described in 2012 the same technique in a "non-reversed" method, performing the distal anastomosis by introducing the commercially intended smooth-tipped distal end of the Viabahn stent into the calcified target artery, reducing the risk of dissection. In the same years, Abou Taam et al. [15] described a different sutureless system for end-to-end anastomosis, successfully tested in the infrarenal aorta of an animal model, consisting of a bare metal stent with spikes covering its outer surface.

These techniques have been used in different contexts of surgical pathology, providing solutions outside the field of iliac rupture during EVAR and TEVAR procedures. Moreover, these techniques could be useful in an elective context, whereas we describe a procedure for an acute setting with a bleeding vessel that requires quick repair.

In conclusion, the importance of accurate iliac artery preparation emerges from this clinical case, especially when large-caliber introducers are required for EVAR and TEVAR procedures. Calcifications and tortuosity increase surgical complexity, making a safety strategy for artery repair, such as the endobypass technique, essential in cases of unexpected iliac artery damage.

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CONFLICTS OF INTEREST

The authors have nothing to disclose.

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AUTHOR CONTRIBUTIONS

Concept and design: DM, FM. Analysis and interpretation: DM, FM. Data collection: FM. Writing the article: DM, FM. Critical revision of the article: FM, FC. Final approval of the article: all authors. Overall responsibility: DM.

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